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Comparison of growth rates of native and non-native juvenile fishes between the Yolo Bypass and the Sacramento River

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Introduction

Floodplains have received great recognition for their role in increasing productivity and habitat diversity in the Sacramento-San Joaquin Delta (Bayley, 1995). Use of inundated floodplains in the Yolo Bypass for spawning, rearing, and migratory pathways by native species can be substantially higher than use of adjacent river channels (Sommer, et al. 2003). Complete inundation of the Yolo Bypass floodplain creates a shallow, low velocity wetland area approximately ten times larger than the comparable reach of the Sacramento River. In addition, floodplains provide an enhanced food web due to elevated productivity associated with the nutrient-rich, warm, shallow water (Sommers et al., 2001).

Sommer et al. (2001) observed that apparent growth rates of Chinook salmon in the Yolo Bypass were greater than in the adjacent mainstem Sacramento River. In this study, we expanded upon this finding, by comparing growth rates of two native species, Sacramento splittail and delta smelt, between the Yolo Bypass and nearby sites on the Sacramento River for three years (2003-2005). In addition, the growth rates of two non-native species, American shad and striped bass, were also compared to determine whether these species would gain similar benefits from floodplains as native species.

Figure 1. Map of northern Sacramento River sampling stations (▲) and Liberty Island.

Figure 2. Images of study species.

Methods

Beach seine sampling was performed by the U.S. Fish and Wildlife Service at permanent sites along the Sacramento River and within Liberty Island (at the southern end of the Yolo Bypass) for three years (2003-2005) (Figures 1 & 3). A 15 x 1.2 m with 3mm delta mesh was passed through the water once at each location at least weekly. All fish were identified to species, measured to nearest mm (forklength) and released. For the purposes of this study, only data for Sacramento splittail, delta smelt, American shad, and striped bass were analyzed (Figure 2).

Growth rates were estimated using the change through time in measured forklengths of individuals caught during sampling. Growth rates were compared between the Yolo Bypass and the Sacramento River by using slopes of ANCOVA models (independent variables: location and date) of each location. Separate ANCOVAs were run for each year and fish species.

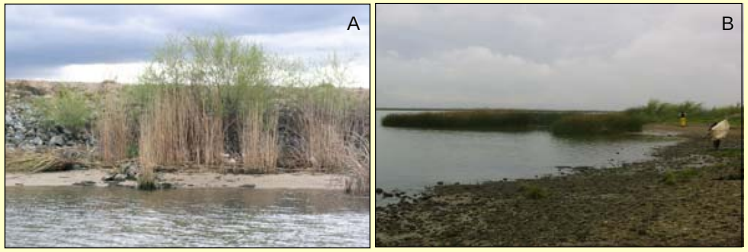

Figure 3. Sampling location photos: A) Sacramento River B) Liberty Island in the Yolo Bypass (Photos courtesy of USFWS.)

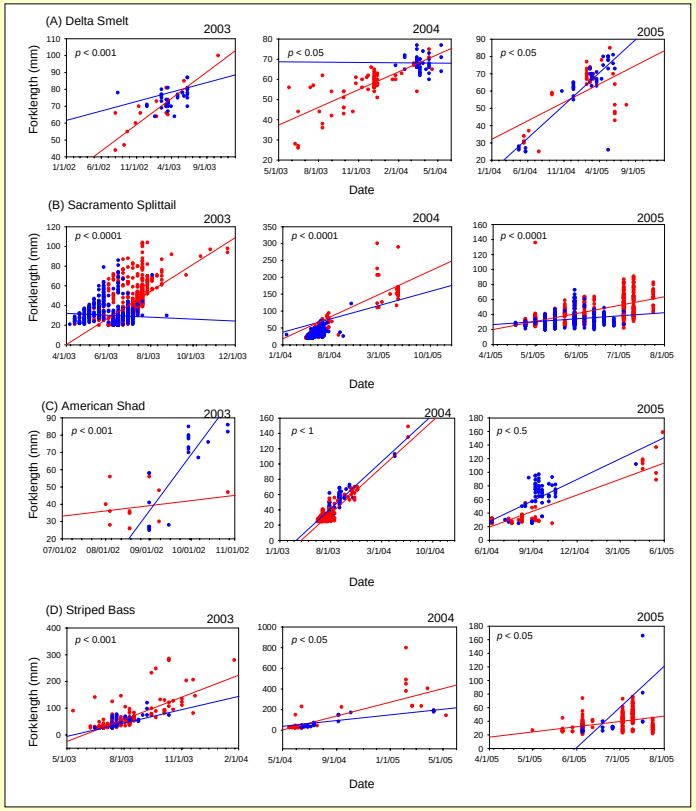

Figure 4. Linear growth rates for Delta Smelt (A), Splittail (B), American Shad (C), and Striped Bass (D) for years 2003 – 2005 at Liberty Island (red) and Sacramento River (blue). Note change in scale among years.

Results

The Yolo Bypass generally supported higher growth rates of native species than the mainstem Sacramento River, but there was no consistent pattern in the growth rates of non-native species. Non-native species did not show as strong of a difference in growth rates between the Yolo Bypass and the adjacent Sacramento River channel (Figure 4).

- Growth rates of **delta smelt** in the Yolo Bypass were higher during 2003 and 2004 .
- Growth rates of **Sacramento splittail** were greater in the Yolo Bypass during all years.
- Growth rates of **American Shad** were greater in the Sacramento River channels, in 2003, but were similar between locations during 2004 and 2005.
- Growth rates of **striped bass** were similar between locations in 2003, but found to be greater in the Yolo Bypass in 2004, and in the Sacramento River during 2005.

Discussion

The Yolo Bypass is reminiscent of the historical Delta region prior to reclamation and channelization when rising waters seasonally inundated floodplains throughout the Delta. Compared to the highly modified Sacramento River, the Yolo Bypass provides increased cover, increased food supply, warmer water temperatures, lower water velocities, lower diversion risk, and lower predation risk (Sommer 2001). Native fishes presumably evolved under a similar suite of environmental conditions and, as a result, should be adapted to benefit from them.

The results of this study support the hypothesis that floodplains provide better conditions for native fishes (Figure 4). We found that growth rates of both delta smelt and Sacramento splittail were greater in the Yolo Bypass than in the Sacramento River. Growth rates of non-natives, however, were not different between the two locations.

This study indicates that native fishes can benefit from floodplains in the Delta through increased growth rates, whereas, non-native fishes do not obtain similar benefits. As a result, the potential for native fishes to gain a competitive advantage over non-natives is greater in floodplains than the channelized waterways. Therefore, restoration and enhancement of floodplain habitat throughout the Delta may provide an effective method for conservation and recovery of native fish species.

Recommendations

Floodplains have been proven to be one of the most productive habitats for native species. In addition, increasing areas of shallow-water habitat in river channels could help to minimize the negative impacts of modified channels. Shallow-water habitats can be enhanced by increasing restoration efforts towards vegetation establishment, levee plantings and restoration, and creating fish passages to prevent strandings. The Sacramento River does pose problems for native fish species which requires further evaluation. The design of the Yolo Bypass should be evaluated to create the most optimal habitat for native and non-native species. This evaluation would include addressing the implementation of fish passages, constructing more wetlands for wildlife and migratory waterfowl, and promoting the area for use during dry seasons. In doing so, it would allow fish to utilize greater parts of the Yolo Bypass, add more nutrients to the soils and create fewer fish strandings. In conclusion, more effort needs to be placed on creating shallow-water habitats within or adjacent to the Sacramento deep-water channels in addition to determining potential design implementations to the Yolo Bypass and adjacent waterways to benefit local fish species, wildlife, and migrating waterfowl.

Literature Cited

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